Networks and Electromagnetic Spectrum (NES) Roadmap

2011 DoD Spectrum Workshop

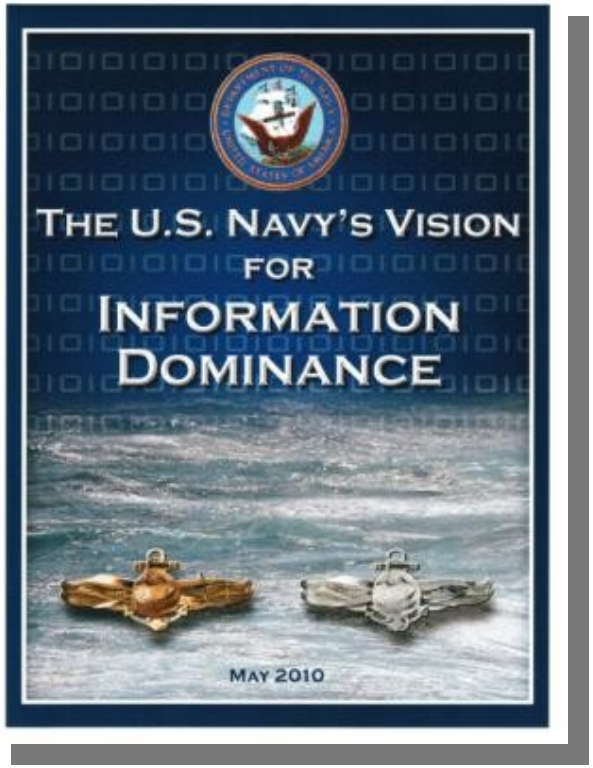
16 DEC 11

Enabling the Information Dominance Vision

Support the Information Dominance Vision with a single unified information environment across tactical, operational and strategic-level spectrum management and networks to assure the commander and warfigh information at the

Key features of NES approach:

- Assured C2 of existing networks and communication infrastructure
- Phased approach to automated, real-time spectrum operations
- Network architecture and data strategy that establishes the grid
- Enterprise services that facilitate information discovery and sharing
- Authorities, oversight, standards and training that instill unity of



Related Guidance

CNO:

- CNO Strategic Studies Group XXIX: Fight in the Complex EM Environment,
  - Critical to force survival are aggressive use of emissions control over the entire EM Terrain (Spectrum)
- Information Dominance – Maintaining the Momentum (ADM Roughead):
  - Recommend TTP for CSG/ESG to dominate the EMS
- Warfighting in the Complex EME (ADM Greenert):
  - In the next two decades, the EM environment may become our most critical warfighting arena

FLEET:

- COMUSFLTFORCOM – 2011 Fleet EW IPCL
  - SM and Real-Time Spectrum Operations concept = Fleet priority

STUDIES:

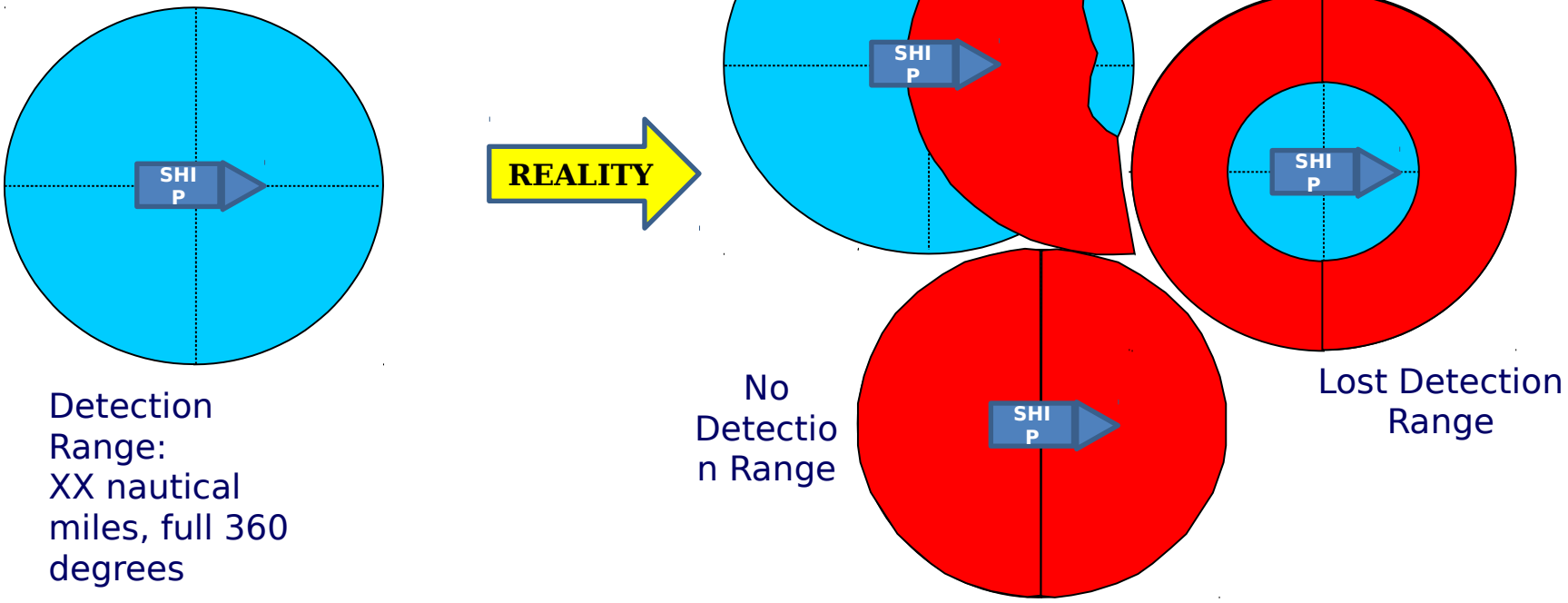
- Center for Naval Analysis (CNA), Countering anti-access measures (A2/AD)
  - Use ALT dispersed FWD operating sites to facilitate more flexible operational support across the region
- Center for Naval Analysis (CNA), Importance of Electromagnetic Spectrum to the Warfighter
  - ID Roadmap for Spectrum Usage, recommend funding for the objectives

CAPT "Jack" Steiner, OPNAV N2N6F12:

- "The Navy specds significant resourses to procure systems optimized to operate in specific spectrum. Then it installs these systems on ships and they interfere with each other. To fix this, the Navy specds additional resources that sub-optimize

The Hidden Problem
Obscured EMI Impacts

- Ship operator assumes system 100% capable
- Actual System Operational Capability



Goal: Make the Assumption the Reality

NES Wholeness / Integration

Networks

Touch Points to all Roadmaps:

- Network Management
- Transport Grid
- Common Connectivity Bus
- Agile Routing
- Fleet Network Operations Center Afloat
- Net-Centric Enterprise Services
- Mobile GIG Entry Points
- DoD IT Enterprise Strategy

Electromagnetic Spectrum

Touch Points to all Roadmaps:

- Congressional Inventory
- National Broadband Plan
- Assured Spectrum Access
- Real Time Spectrum Ops
- Improve SPY-1 Interoperability
- Linkage to NTAs
- Denied Environments
- World Radio Conference agenda items (ex., UAS

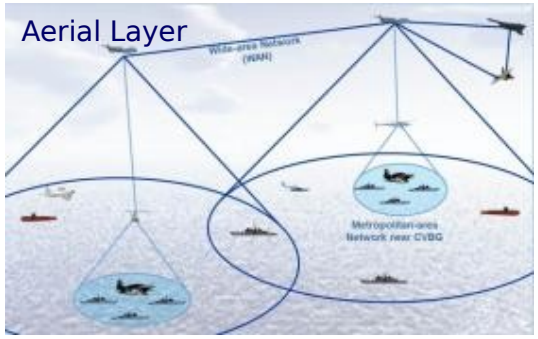
NES Approach

Leverage existing efforts:

- A2/AD
- Joint Aerial Layer Network (JALN)
- Automated Radio Communications (ARC) / eXtensible Communications Automation Framework (XCAFE)
- Afloat EM Spectrum Operations Program (AESOP)
- Navy Enterprise Networks (NEN) Ashore Integration
- CANES (Afloat Integration)
- Spectral Warrior / SpiderNet
- Trident Warrior

Leverage Current and Future Technology

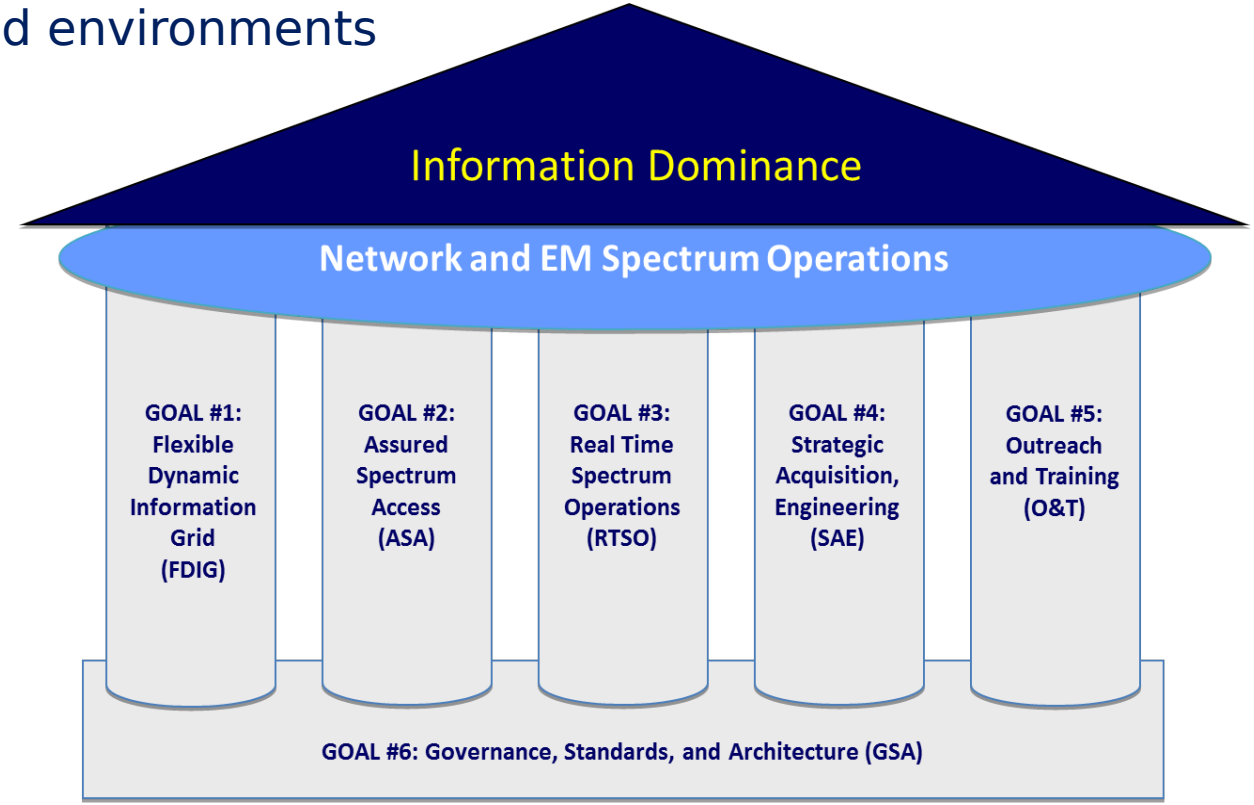
- Cognitive Radios / Dynamic Spectrum Access
- ONR: Integrated Topside: Innovative Naval Prototype (INP) program
- NRL:
  - Resource Allocation Manager (RAM)
  - Multifunction Electronic Warfare (MFEW) ADM
  - Advanced Multifunction RF Concept (AMRFC) Test Bed



MFEW on LSD 45

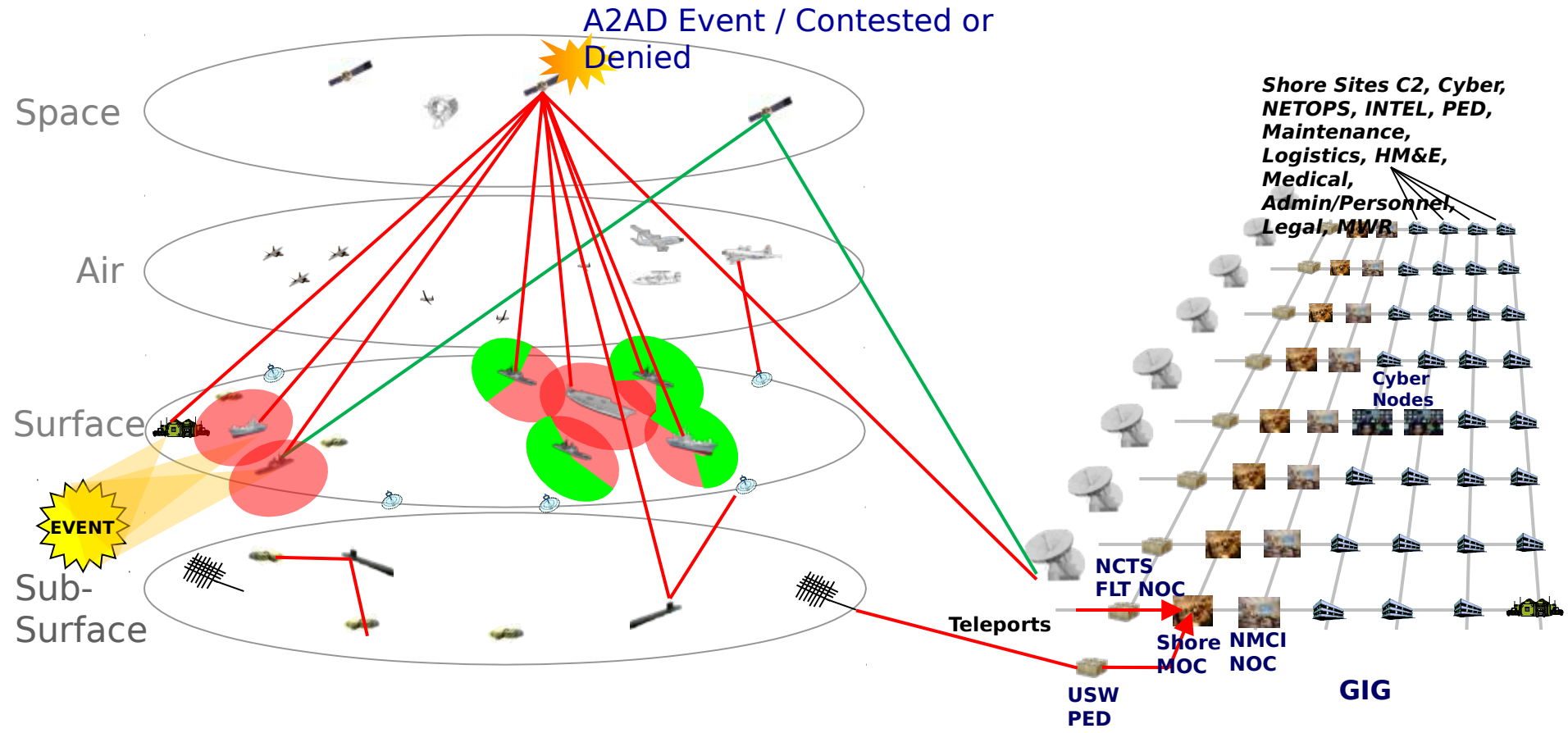
NES Vision and Goals

- Develop and establish a complete portfolio of reliable, highly-interoperable network and electromagnetic spectrum capabilities
- Manage through a flexible, dynamic information grid that maximizes the ability of the warfighter to access, maneuver, and achieve decision superiority in, A2AD, benign, degraded and denied environments


Information Dominance
Network and EM Spectrum Operations
GOAL #1: Flexible Dynamic Information Grid (FDIG)
GOAL #2: Assured Spectrum Access (ASA)
GOAL #3: Real Time Spectrum Operations (RTSO)
GOAL #4: Strategic Acquisition, Engineering (SAE)
GOAL #5: Outreach and Training (O&T)
GOAL #6: Governance, Standards, and Architecture (GSA)

NES Overarching View

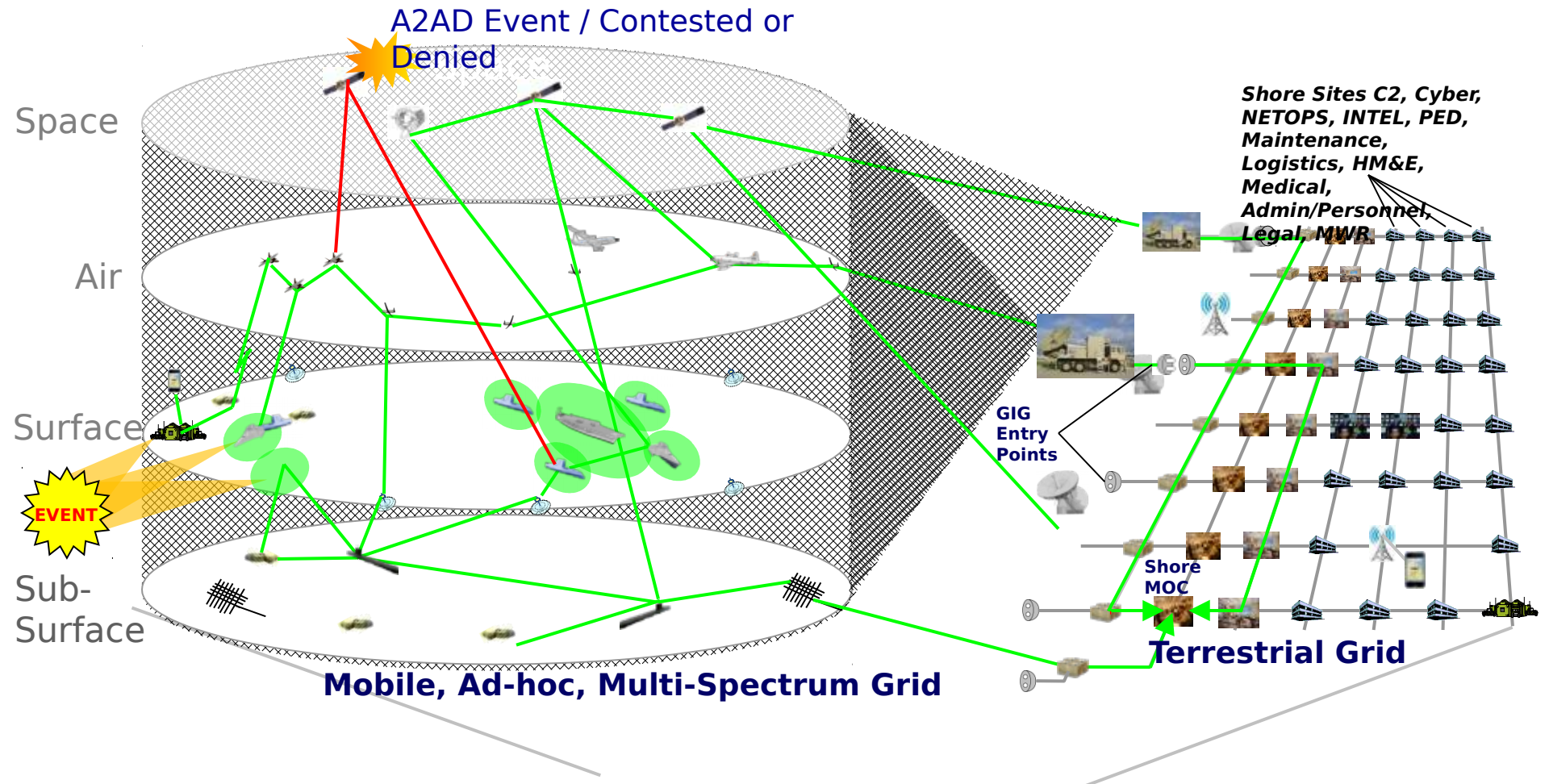
As-Is 2011



Point-to-point comms, specialized comms relays, reliance on Space Layer for connection to GIG, platforms are degraded

NES Overarching View

To-be Vision 2025

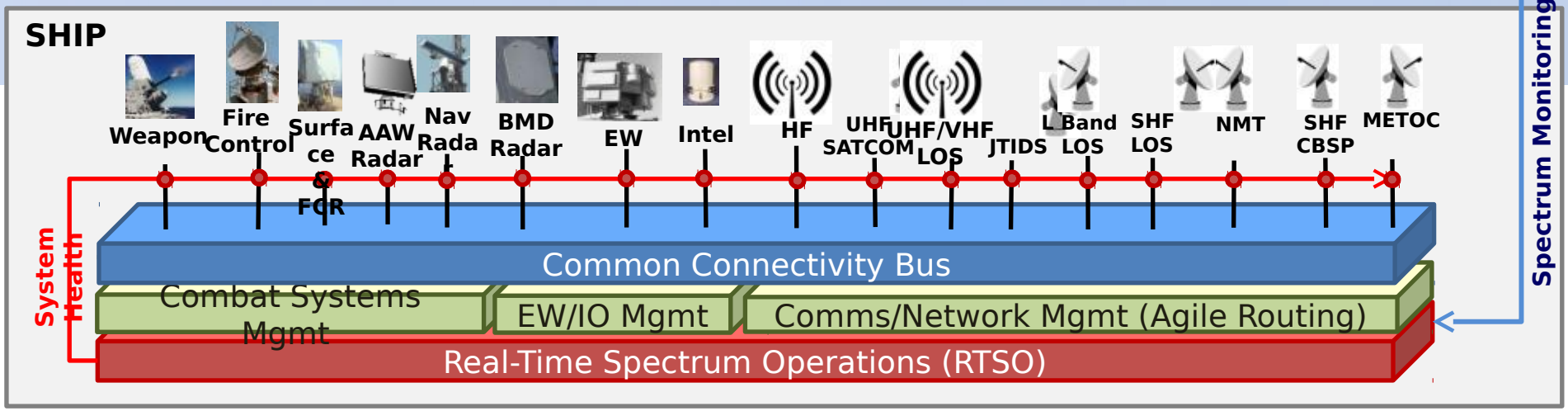


Global Information Grid

Every node connects to the Grid, every node supports the Grid, Platforms have full combat capability

NES Ship Level Vision

External Ship Electromagnetic Environment (EME)

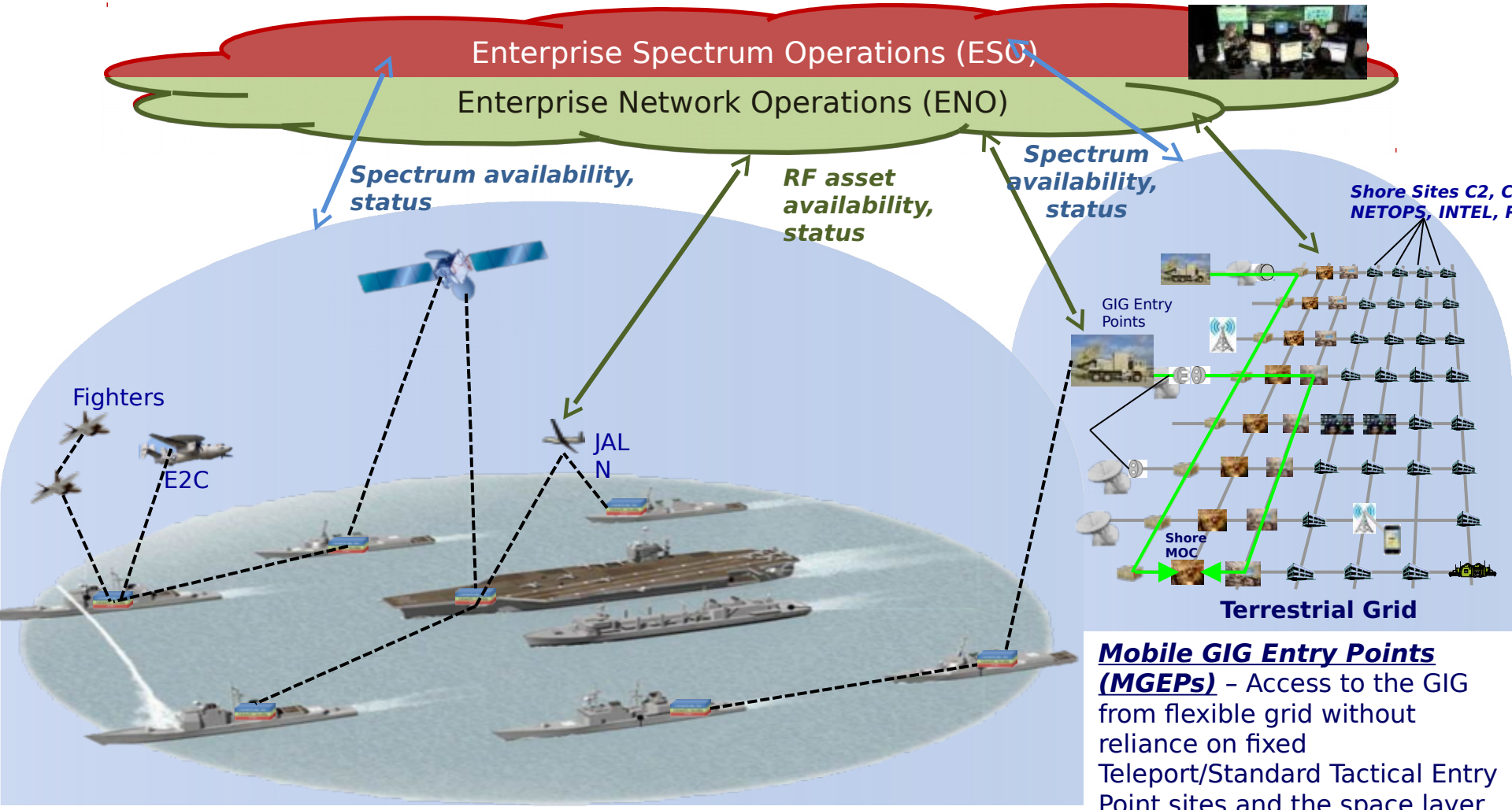


Afloat Management and Control (Common Connectivity Bus) – Physical routing of shipboard traffic based on spectrum and routing assignments

Comms/Network Management (Agile Routing) – Dynamic, logical routing of shipboard traffic based on enterprise and shipboard spectrum and network availability

Real-Time Spectrum Operations (RTSO) – SA and Control of shipboard spectrum

NES Enterprise Level Vision



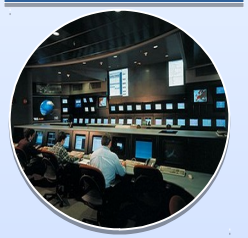
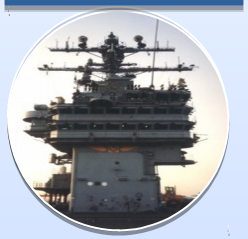
Mobile GIG Entry Points (MGEPs) – Access to the GIG from flexible grid without reliance on fixed Teleport/Standard Tactical Entry Point sites and the space layer

Enterprise Network Operations – Enterprise network SA, path availability and dynamic network and routing management

Enterprise Spectrum Operations – Enterprise spectrum SA, availability and dynamic spectrum access

Virtual Secure Enclaves – Secure sub networks between operationally dependent nodes, managed by

Real-Time Spectrum Operations (RTSO)

TODAY	INCR. 1	INCR. 2	INCR. 3
			
Man in the Loop (MIL) Minutes	Man on the Loop (MOL) Seconds	Combat Systems (MIL) LOS COMMS (MOL)	Machine to Machine (M2M) Milliseconds

RTSO enables interoperable Core Capabilities

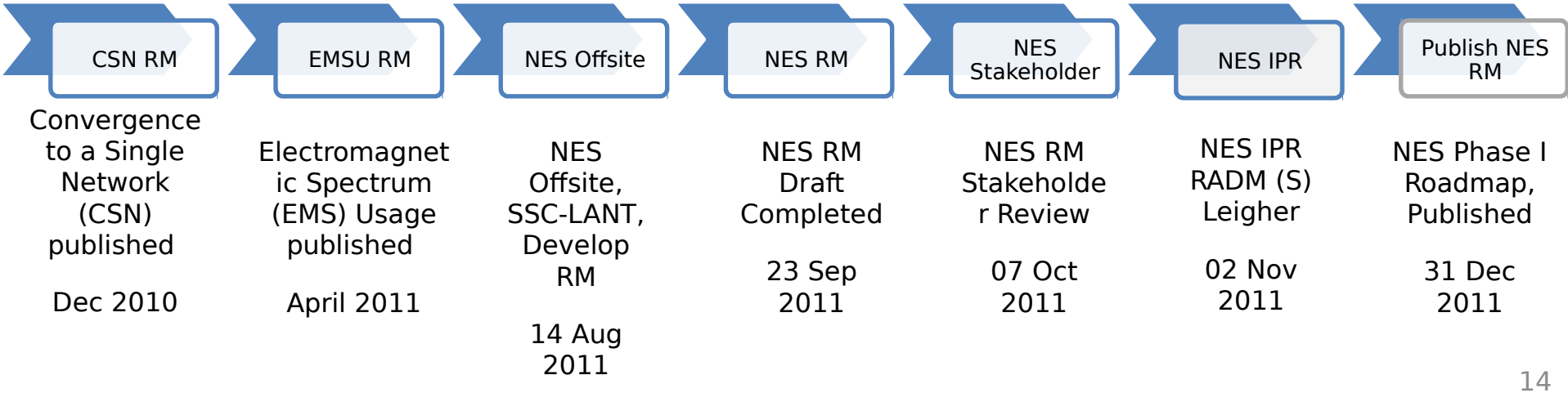
COMUSFLTFORCOM – 2011 Fleet EW Integrated Prioritized Capabilities List (IPCL)
Specifically highlights Spectrum Management and Real-Time Spectrum Operations (RTSO) concept development as a Fleet priority.

Backup

NES Roadmap Background

- The Maritime Strategy for the 21st century addresses the global challenges that face U.S. Naval Forces
- Foundational to these challenges is our ability to have assured access to mission critical information in A2AD, benign, degraded and denied operational environments
- This can only be accomplished by having flexible and dynamic access to and control of the Electromagnetic Spectrum (EMS) and Navy Networks

NES Phase I Roadmap Timeline



NES Roadmap Action Plan

Flexible Dynamic Information Grid (FDIG)		Assured Spectrum Access (ASA)	Real Time Spectrum Operations (RTSO)	Strategic Acquisition, Engineering (SAE)	Outreach and Training (O&T)
1.1 Network Management	1.7 Afloat Mgmt. and	2.1 EMS Requirements	3.1 Transition Plan	4.1 EMS Utilization Plan	5.1 NETOPS PQS
1.2 Asset Discovery	1.8 NOC Services Afloat	2.2 Spectrum Utilization	3.2 Develop, Test & Field, INCR 1, 2 and 3	4.2 Spectrum & Network Rqmts.	5.2 NETOPS TTP and Training
1.3 Integrated Shipboard	1.9 Enterprise Services			4.3 EME Evaluation M&S	5.3 Mission Focused Force
1.4 Transport Grid, MGEP	1.10 Implement VSEs	2.3 Warfighter Access	3.3 Data and Rule Sets	4.4 Spectrum Digital Cert.	5.4 Career Continuum
1.5 Consolidate Ashore Network	1.11 Data Mgmt Strategy	2.4 National & International Spectrum Access		4.5 Network T&E	5.5 Training Solutions
1.6 Agile Routing					5.6 E3/Spectrum DAWIA
Governance, Standards, and Architecture (GSA)					
6.1 Enterprise Governance	6.2 Enterprise Architecture	6.3 Interoperability Standards	6.4 CONOPS / Threats		

NES FY 12 Action Plan

GOALS	OBJECTIVES	FY12 PRODUCTS	SUSPENSE (IOC)
1 - Flexible Dynamic Information Grid	Transport Grid Capability Analysis, MGEPs	Transport Grid Requirements	***FY2011, Q3***
	FLTNOC Services Afloat	FLTNOC Requirements	FY2012, Q2
	Consolidate Ashore Networks	Ashore Network Consolidation Plan	FY2012, Q4
	Network Management Capability	Network Management Architecture	FY2013, Q1
2 - Assured Spectrum Access (ASA)	Defend Navy's EMS Requirements.	2-NBP Reports (Fast Trk & 1755-1850 MHz)	FY2014, Q4
	Protect National Spectrum Access for Homeland Defense	TX/RCV STDs	FY2014, Q4
	Ensure the Warfighter has Access to the EMS It Needs	WRC Impacts, Feb 12	FY2016, Q4
	Control and Improve Spectrum Utilization	S-Band Amplifier and MBCP Initiative	FY2018, Q2
3 - Real Time Spectrum Operations (RTSO)	Develop RTSO Transition Plan	Transition Plan	FY2016, Q3
	Develop, Test, and Field RTSO INCR 1, INCR 2	QW #1: OPTASKCOM Demo, RTSO INCR 1	FY2022, Q2
	Develop Data and Rule Sets to Support RTSO	Rule Set	FY2020, Q2
4 - Strategic Acquisition, Engineering (SAE)	Early Assessment of Spectrum and Network Requirements	QW#2: SSRA pre-MS A	FY2013, Q4
	Thorough System Full-EME Evaluation Modeling and Simulation and Test and Evaluation	GC #9: Smart Card Investigation	FY2014, Q4
	Develop EMS Utilization Plan (UP)	13-16 GHz EMS UP	FY2016, Q1
	Spectrum Digital Certification	IOC Mod/Sim Tool for SSRA, QW #3: DT/OT	FY2018, Q4
5 - Outreach and Training	Deliver a mission-focused force	PQS, OCCSTDS, PTEP, Task Unit Exams	FY2014, Q1
	Deliver agile, innovative, and flexible training solutions	OP Curriculum	FY2016, Q3
	Implement E3/Spectrum Awareness training into the DAWIA certification process.	ACQ Curriculum	FY2016, Q3
	Provide a career continuum of training, education, and experiential learning	NTSP, Administer PTEP, T/U Exam, NKO COP	FY2017, Q2
6 - Provide NES Governance, Standards, and Architecture	Enterprise Governance (Authorities, Compliance, and Enforcement Mechanisms)	OPNAVINST 2400.20X	FY2012, Q4
	Develop Navy Enterprise Network Architecture, Integrated with DoD, Joint, Coalition, IC, and NGO Networks	NES INCR 1 Integrated Architecture	FY2013, Q1
	CONOPS/Threats	NES Warfighting CONOPS	FY2013, Q1

Complete

NES Quick Wins Overview

Informing Navy Program Decisions

Operational Capability:

- C.1.3 Quick Win #3: SAE, Include EMI Testing in DT/OT/SOVT Test Events: Integrate appropriate EMI testing in DT/OT test events.

Policy and Process:

- C.1.2 Quick Win #2: SAE, Technical SSRA Pre-Milestone A: Implement a process change for the development and delivery of a technical spectrum data prior to system Milestone A.

Fleet Demonstrations:

- C.1.1 Quick Win #1: RTSO, Semi-Automatic OPTASKCOM Demonstration: Demonstrate the Afloat Electromagnetic Spectrum Operations Program (AESOP) to load /update OPTASKCOMMs on an ARG COMM Suite automatically.
- C.1.4 Quick Win #4: O&T, Contested EMS Environment – Afloat, (Increased Fleet Operational Awareness): Assist C2F and C3F C2X and Joint Task Force Exercise (JTFEX) to implement spectrum training requirements in a stressed-like deployment environment.
- C.1.5 Quick Win #5: O&T, Contested EMS Environment – Ashore: Administer spectrum drills on Navy Shore establishment to force spectrum manipulations. Utilize a JTFEX to simulate enemy denial of service attacks through kinetic, cyber, or EW means.

ote: C.1.X – is a reference to Appendix C in the NES Roadmap

NES Game Changers Overview

Intelligent, Self-Synchronizing, Transparent

C.2.1 GC #1: FDIG, Enterprise Asset Management: Discover components (servers, workstations, devices, applications, services, network infrastructure) as they connect to the network environment.

C.2.2 GC #2: FDIG, Network Consolidation: Investigate technologies capable of integrating and consolidating shipboard networks, including technologies available to support a common shipboard antenna connectivity bus.

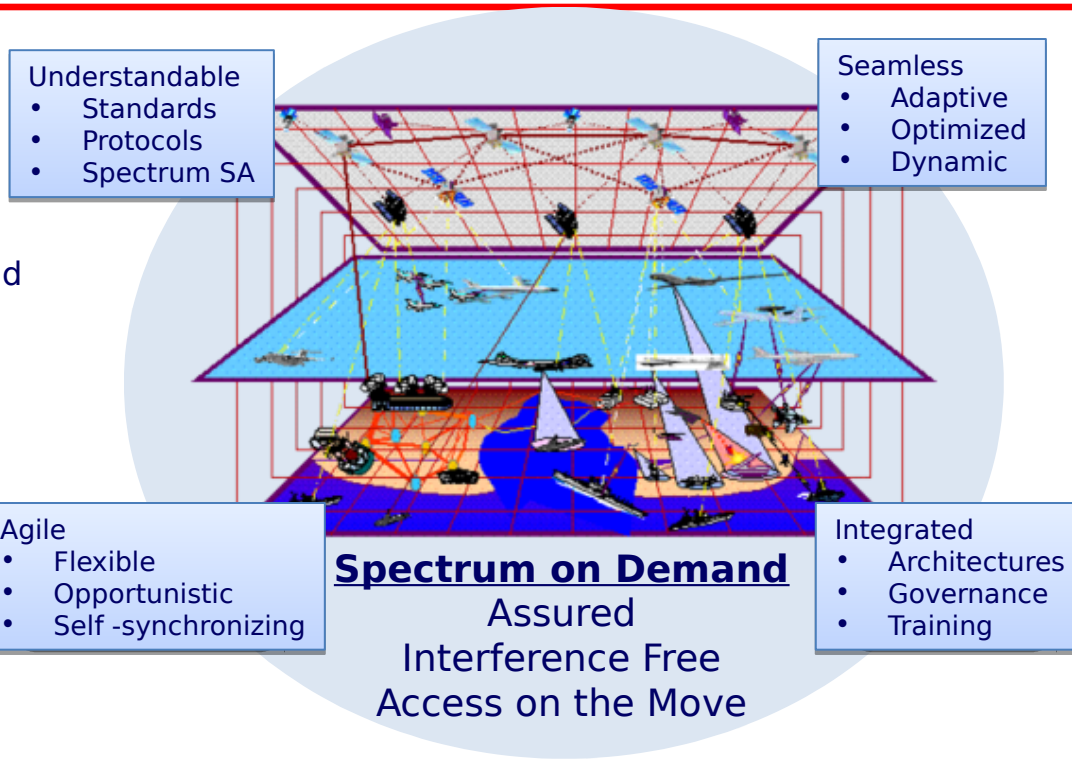
C.2.3 GC #3: FDIG, Virtual Secure Enclaves: The creation of ONDs and associated VSEs and ASEs permits information sharing and protection within a single information security domain.

C.2.4 GC #4: FDIG, Mobile Ad Hoc Networking: Leverage ONR's Dynamic Tactical Communication Networks, an enabling capability that will deliver technologies to meet the requirements for more dynamic and scalable routing in tactical networks.

C.2.5 GC #5: ASA, Integrated Topside Design: Integrated, multi-spectrum arrays providing dynamic access.

C.2.6 GC #6: ASA, SPY-1 Interoperability: The AN/SPY-1 radar Out-Of-Band (OOB) emissions limit its usage near shore, invest in low noise, solid state amplifiers to improve interoperability.

C.2.7 GC #7: RTSO, Spectrum Agile Radios: Systems can adjust their EM Spectrum utilization in response to changing circumstances and military objectives.



C.2.8 GC #8: RTSO, Real-Time Battle-space Awareness: Real-time spectrum sensing provides shared situational awareness that enables collaboration and speed of command.

C.2.9 GC #9: SAE, Smart Card Technology: All systems will have an embedded smart card (or digital cert). Smart Cards allow system authentication, provide system health status.

C.2.10 GC #10: Entire Roadmap, Autonomous Systems: An increased OP Tempo will be achieved through the use of Autonomous and semi-auto Systems, providing a more flexible and dynamic force.

National Broadband Plan (NBP)

Spectrum Bands Being Considered (Goal #2: ASA)

Band Study Prioritizations

L Low - Reallocation Impacts minimal

NTIA Top Priority Bands

M Medium - Reallocation Impacts significant

H High - Reallocation Impacts Critical, band should not be pursued

Band MHz	Reallocation Impacts	Key Navy and DOD Systems	Other Federal Users
406.1 – 420	3	Non-Tactical Land Mobile Radio Systems	DOC, DHS, GSA, DOJ
1300 - 1390 (1370 – 1390)	4	Long Range Search Radars, Range Data Links, Cobra Dane, Tactical Comms (SRC-57 / MRC-142) Lightweight Counter Mortar Radar (Army), GPS	FAA, DHS, NSF, TVA, NASA
1675 – 1695 (Fast Track 1695 – 1710)	2	Meteorological Satellite (GOES) downlinks and Radiosondes	DOC, NOAA, NASA
1755 - 1780	1	Space Ground Link Subsystem (SGLS uplink); UAVs – Pointer, Raven, others; Tactical Comms (HCLOS, DWTS, SRC-57); Air Combat Training Systems; Precision Guided Munitions (PGMs); Sustaining Base Operations	DOJ, DOA, DOC, DHS, DOE, FAA, DOI, NASA, TVA, NSF, VA, HUD
1780 - 1850			DOJ, DOA, AID, DOC, DHS, DOE, EPA, FAA, HHS, HUD, DOI, OPM
2200 – 2290		Missile telemetry, Airborne telemetry, Space Ground Link Subsystem (SGLS downlink)	DOA, DOC, DHS, GSA, DOI, DOT, DOJ
2700 – 2900		Ground and Maritime Air surveillance radars, future Navy radars	FAA, NOAA, DOE
2900 - 3100		Ground penetrating and weather radars, Maritime Navigational radars, future Navy radars (BMD)	NOAA, DOE
3100 - 3500	6	DDG/CG Aegis SPY-1 Weapon System (Radar and Missile guidance); Army Fire Finder counter battery radar; Airborne radar; future Navy radars (BMD)	DOE
3500 – 3650 MHz	5	Airborne Station Keeping Equipment, Shipboard Air Traffic Control radar, future	DOE

Reallocation impacts determined by OPNAV, Fleet, and PEO